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FEDERAL COMMUNICATIONS COMMISSION
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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Allocation of Spectrum	)	ET Docket No. 94-32
Below 5 GHz Transferred from	)	
Federal Government Use	)	[redacted]

COMMENTS OF MOTOROLA

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Motorola, by its attorneys, hereby submits its comments in response to the FCC's *Second Notice of Proposed Rule Making* in the above captioned matter.[1] In this phase of this landmark proceeding, the Commission is attempting to craft services rules that complement and refine its recent allocation decisions for the 2390-2400 MHz, 2402-2417 MHz and the 4660-4685 MHz frequency bands. While Motorola is deeply concerned that a spectrum allocation for private land mobile service was not part of the FCC's initial decisions, there may be preferred spectrum homes for private users beyond these first 50 MHz. Therefore, Motorola strongly urges the Commission to complete its analysis of the needs of private wireless services in order to identify appropriate spectrum that will become available through the continued government reallocation process. In other matters, Motorola comments on the appropriate technical standards for operation of Part 15 devices in the 2390-2400 MHz and the 2400-2483.5 MHz bands.

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[1] *First Report and Order and Second Notice of Proposed Rule Making*, ET Docket No. 94-32, 60 Fed. Reg. 13071 (1995) (hereinafter *Second Notice*).

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I. SUMMARY & BACKGROUND

In Title VI of the Omnibus Budget Reconciliation Act of 1993, Congress directed the NTIA to recommend the reallocation of at least 200 MHz of Federal spectrum below 5 GHz to non-government users.[2] Congress further specified that at least 50 MHz of this total must be reallocated "immediately" to the private sector. The spectrum identified for immediate reallocation is the subject of this FCC proceeding, namely the 2390-2400 MHz, 2402-2417 MHz and 4660-4685 MHz frequency bands. In a related action mandated by the same legislation, Congress also directed the Commission to analyze the spectrum requirements of public safety agencies.[3]

After conducting a public inquiry on the potential uses of this spectrum, the Commission originally proposed to allocate these three bands to generic fixed and mobile licensed services and to employ competitive bidding procedures to issue licenses.[4] As recognized by the Commission in its *Second Notice*, a majority of commenters expressed concern that such proposals appear to encourage "allocations by auction" and, in any event, failed to address the spectrum needs for specific services and technologies such as Part 15 spread spectrum operations in the 2.4 GHz band. Other parties supported specific allocations for the 2390-2400 MHz and the 2300-2310 MHz bands such as wireless local loop access or ground to air entertainment services.

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[2] Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, § 6001, 107 Stat. 312, 379-401 (1993), 47 U.S.C. §§ 111-117.

[3] *Id.* at § 6001(a)(3).

[4] *Notice of Proposed Rule Making*, ET Docket No. 94-32, 9 FCC Rcd 6779 (1994).

For its part, Motorola argued that the proposal failed to accommodate the needs of private land mobile users, who would not be able to fairly compete with commercial operators in any competitive bidding scenario. Motorola therefore recommended that the Commission allocate the 2390-2400 MHz and the 2300-2310 MHz bands for private wireless services. As an alterative -- perhaps even preferable from an engineering perspective -- Motorola recommended that the Commission allocate the 380-400 MHz and the 1710-1755 MHz bands for private wireless services. Finally, Motorola urged the Commission to protect and preserve opportunities in the 2400-2483.5 MHz band for unlicensed Part 15 spread spectrum devices in which a number of manufacturers, including Motorola, have invested research and development resources.

Upon review of the comments, the FCC issued its *First Report and Order* and allocated the 2390-2400 MHz band for unlicensed PCS devices and decided to continue to provide for Part 15 unlicensed operations in the 2402-2417 MHz band.[5] The Commission did, however, adopt its proposal to allocate the 4660-4685 MHz band for generic fixed and mobile services with license auction winners determining how the spectrum would be used within these broad service categories. In large part, the purpose of the *Second Notice* is to solicit comments on appropriate service and assignment rules for the newly proposed General Wireless Communications Service in the 4.6 GHz band. Also, the Commission raises questions about certain technical standards and the sharing environment for the two 2.4 GHz bands.

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[5] In addition, the FCC upgraded the allocation status of the Amateur Service to primary in each of these two bands.

The actions taken by the Commission with regard to the first 50 MHz of spectrum transferred from Federal use clearly do not address the needs of public safety or other private wireless users. These requirements were identified over a year ago in the Petition for Rule Making filed by the Coalition of Private Users of Emerging Multimedia Technologies (COPE) and amplified by Motorola and other private users through comments filed throughout the proceeding. Given the showing of demonstrated needs, Motorola trusts that the Commission will take definitive action with respect to the remaining Federal spectrum to meet these needs. As addressed in Section II of these comments -- as well as the attached appendix -- spectrum below 3 GHz is essential to provide cost effective wide area coverage required by private wireless users.

Time is short. The Commission is required by Congress to develop an overall plan by February 1996 for allocating the remaining 185 MHz of spectrum transferred through the NTIA.[6] Given the contribution of private wireless services in supporting crime control, industrial productivity and health care, it would be contrary to the public interest for the FCC to exclude these services from that plan.

With regard to unlicensed use of the 2390-2400 MHz and the 2402-2417 MHZ bands, Motorola recommends in Section II of these comments technical standards that will make the most effective use of that spectrum.

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[6] The NTIA Final Report, dated February 1995, and released on March 15, 1995, identifies a total of 235 MHz of spectrum for transfer.

II. THE COMMISSION HAS NOT ADEQUATELY ADDRESSED THE NEED FOR ADVANCED WIDE AREA LAND MOBILE SPECTRUM

For the past several years, Motorola has indicated to both the Commission and the NTIA that the single most critical unmet spectrum need in the U.S. is for advanced wide area land mobile systems for private users. In comments previously filed in this proceeding, Motorola noted that existing allocations either contain insufficient quantities of spectrum or are too congested to accommodate the variety of advanced data, video and control applications needed by public safety, public service and industrial entities to improve the overall efficiency and effectiveness of these radio users.[7] Perhaps more importantly, Motorola pointed out that the record contains conclusive evidence that private users cannot rely on commercial service providers to help address their needs as contemplated by the FCC.[8] The Commission recently was presented with first hand evidence from private users on the inability of carrier systems to meet their requirements.[9]

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[7] Reply Comments of Motorola, Inc., ET Docket No. 94-32, filed January 6, 1995.

[8] Id.

[9] On March 1, 1995, the Land Mobile Communications Council sponsored an informational seminar for FCC staff on private wireless systems.

Notwithstanding the overwhelming evidence contained in the record, the Commission decided against an allocation for private land mobile purposes in its *First Report and Order* claiming that 1) private users can avail themselves to Part 15 devices for their data needs, 2) private users can gain additional capacity in existing allocations through the implementation of more efficient technology, and 3) the proposed General Wireless Communications Service at 4.6 GHz can be used for private "dispatch service." Motorola believes that such analysis reflects an inaccurate understanding of the needs of private users and an exaggeration of the usefulness of the 4.6 GHz band for terrestrial wide area mobile applications.

First, Motorola strongly objects to the suggestion that private users should rely on Part 15 devices to satisfy their advanced wide area needs. As described in the COPE Petition, the primary need is for advanced "wide area" operations for which low power Part 15 devices offer little potential for relief. In addition, Part 15 devices do not offer the control or security often needed by many public safety, public service and industrial wide area operations.

Second, the statement that private land mobile users can increase capacity through implementation of more spectrum efficient technologies implies that private users currently use the spectrum in an inefficient manner. However, as the FCC is well aware, the frequency bands under consideration in the *Refarming Proceeding* cited by the Commission are undoubtedly the most intensively used bands among any regulated by the FCC. Over 16 million transmitters are currently licensed to operate in

about 36 MHz of assignable spectrum.[10] This exceeds the density of other radio bands licensed by the Commission.

Furthermore, channel splitting in the existing private land mobile bands may create more voice channels but not necessarily result in significantly more communications capacity. For example, Motorola remains concerned that increasing the number of narrowband emitters in a finite portion of spectrum will substantially increase adjacent channel and intermodulation interference effects thereby limiting overall throughput. Also, reducing channel bandwidth will not address the primary need -- advanced wide area communications -- that go beyond simple push-to-talk technologies and that require greater bandwidths.

Finally, the Commission's apparent reliance that the 4.6 GHz allocation can be used for terrestrial land mobile services ignores data submitted by Motorola earlier in this spectrum reallocation process. In response to preliminary NTIA efforts at identifying issues relevant for the government spectrum transfer, Motorola provided an analysis on the cost factors associated with using frequencies above 3 GHz for wide area land mobile applications. In that paper, attached hereto as Appendix A, Motorola concluded that the additional infrastructure needed to support wide area mobile operations at frequencies above 3 GHz would cost up to 30 times that experienced today in lower bands. This cost penalty, which is not based on factors remedied

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[10] This total includes approximately 12 MHz of assignable spectrum in the 470-512 MHz band that is available in 11 of the top U.S. markets. *See* 47 C.F.R. § 90.301 *et. seq.*

through economies of scale, renders the 4.6 GHz band extremely unattractive for wide area terrestrial land mobile services.

While Motorola is deeply concerned that a spectrum allocation for private land mobile was not part of the *First Report and Order*, it recognizes that the frequency bands available were not the best candidates for addressing this need. Of greater concern, therefore, is the apparent misunderstanding by the FCC of this industry's needs. While both carrier operations and unlicensed systems provide solutions for some niche requirements of private users, the mainstream communications needs of many private users cannot be met through such technologies. Notwithstanding its public support for increased competition, the Commission is apparently contemplating reducing the option private users now have to choose between internally operated systems and carrier provided services. Motorola submits that such an action would be extremely damaging to U.S. competitiveness. At the March 1 private land mobile briefing before FCC staff,[11] for example, a representative from Federal Express related its experience in other markets/countries where the private system option is not available. That representative stated that the lack of private wireless communications tends to hamper business operations and raise the cost of doing business. Clearly, such results should not be the desired outcome of FCC policies.

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[11] *See* note 9, *supra*.

Motorola notes that the Commission indicated that it would again consider the need for additional allocations in its on-going analysis of the communications needs of public safety entities.[12] Although positive, this further consideration will not provide any hope to private users that do not meet the FCC's strict definition of public safety.[13] Motorola therefore urges the Commission to continue its analysis of private users' needs and to identify appropriate frequency bands from those available through the government transfer process for reallocation to all private wireless services. Once again, Motorola recommends that the Commission give strong consideration to the 380-400 MHz and the 1710-1755 MHz bands for this purpose.

III. MOTOROLA SUPPORTS THE TECHNICAL STANDARDS ADOPTED FOR THE 2390-2400 MHz BAND

The *Second Notice* recognizes the proximity and the similarity between the 2390-2400 MHz and the 2400-2483.5 MHz bands but notes that the existing rules would effectively preclude operations covering both bands.[14] Therefore, the FCC seeks comment on whether some allowance should be made to accommodate operations that combine use of the bands. In addition, the *Second Notice* seeks comment on the

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[12] *See* note 3 *supra.*

[13] Many quasi-governmental utility or industrial radio users provide a large measure of public safety but do not satisfy the FCC's definitions. Hazardous material clean-up crews of industrial corporations are but one example.

[14] *Second Notice* at ¶55.

sharing compatibility of unlicensed devices with other authorized services including amateur operations.[15]

Motorola notes that the technical rules for the 2390-2400 MHz band are contained at 47 C.F.R. §15.301 *et. seq.* which specifically require devices to conform to the "Spectrum Etiquette" originally developed by WINForum for asynchronous devices operating in the unlicensed PCS band at 1910-1930 MHz. On the other hand, the technical standards for Part 15 devices operating in the 2400-2483.5 MHz are more flexible in terms of specifying permissible technical operations.[16] After considering the various regulatory options, Motorola initially recommends that the FCC proceed with the policies and rules as presently drafted. It may be imprudent, for example, to impose the "listen before talk" provisions of the Spectrum Etiquette to devices intended to operate in the existing 2.4 GHz ISM band whose development is well advanced. Furthermore, Motorola notes that the Part 15 rules allows unlicensed devices other than wireless data devices for which the applicability of the Spectrum Etiquette is questionable. For these reasons, Motorola is concerned about extending the scope of these rules to include devices operating at 2400-2483.5 MHz. We do note, however, that additional industry discussions are occurring on this issue and more definitive positions should be evident in the coming weeks.

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[15] *Id.* at ¶56-59.

[16] *See* 47 C.F.R. §15.247.

On the other hand, Motorola supports the FCC's reliance on the etiquette for new products to be developed specifically for the 2390-2400 MHz band. The etiquette represents the best effort of this nation's leading manufacturers to ensure a stable operating environment for a variety of disparate radio technologies. Given that the 2390-2400 MHz is devoid of existing users, it is appropriate to now encourage the maintenance of an organized spectrum home that will better accommodate higher speed devices. For these reasons, Motorola supports the Commission's actions for imposing the rules originally developed for asynchronous devices operating at 1910-1930 MHz for the 2390-2400 MHz band.[17] Of course, the spectrum etiquette is a well-intentioned but theoretical approach to accommodating a wide variety of devices in one frequency band. Once the etiquette is tested in the real world environment it may be appropriate to revisit its specifications. Motorola recommends that the FCC monitor this situation and remain vigilant to potential needed modifications.

The FCC's *Second Notice* also seeks comments on the compatibility of unlicensed PCS operations and the amateur service while tentatively concluding that it is unnecessary to propose formal sharing standards for these two services.[18] Motorola agrees that, at a technical level, typical operations of these two services should raise little interference potential. However, Motorola is concerned that unlicensed PCS

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[17] However, Motorola does question the relevance of the so-called "packing" provisions of the etiquette codified at Section 15.321(b). With the increased flexibility available through the use of clear spectrum, it may prove more spectrally efficient to allow dynamic channel assignments.

[18] *Second Notice* at ¶57.

devices remain secondary to amateur operations. This is not a technical concern given the robust design of unlicensed devices. However, customers of Part 15 devices may develop negative perceptions of secondary status if primary users arbitrarily claim interference received. Motorola notes that unlicensed PCS operations in the 1910-1930 MHz band will not face this issue since they have been accorded co-primary status with fixed microwave operations.[19] As a matter of equity, the FCC should elevate the status of unlicensed PCS in the 2390-2400 MHz band to co-primary with the amateur service. As an alternative, Motorola recommends defining the parameters under which unlicensed devices are presumed not to cause interference. Previously, Motorola recommended that any Part 15 device operating within the 2400-2483.5 MHz band transmitting an average EIRP of 25 milliwatts or less measured in a 1 MHz bandwidth over a one second period be presumed incapable of causing interference to any service of a higher priority.[20]

IV. CONCLUSION

The transfer of more than 200 MHz of spectrum to non-Federal use holds great opportunities for the American public. In Motorola's view, private wireless systems provide great benefits to society and warrant the utmost consideration in the FCC's planning for the allocation of the transferred spectrum. To do so otherwise in the face

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[19] *See* 47 C.F.R. § 2.106.

[20] A similar presumption should be implemented for the 2390-2400 MHz band based on the maximum permitted power allowed by the Spectrum Etiquette.

of explicitly detailed needs would suggest that auction revenues are driving U.S. spectrum management policies. Clearly, such a result is undesired and contrary to the intent of Congress.

Respectfully Submitted,

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APPENDIX A

ABSTRACT
The cost of RF devices low loss transmission lines and other components increase at higher frequencies. The path loss and transmission line loss increases at the higher frequencies faster than antenna gain can offset them. Also, there are limitations on transmitted power from a portable imposed by maintaining the level of exposure of the user within accepted safe standards. Thus, costly system techniques must be implemented to maintain wide area coverage at higher frequencies comparable to that of lower frequencies.

Thus, the cost of obtaining the wide area coverage makes it difficult, if not impossible to provide a cost effective service at the higher frequencies (above 2 to 3 GHz) being considered by the SPAC.

INTRODUCTION
Several questions have been asked by the SPAC as deliberations proceed regarding the 200 MHz of spectrum which will be reallocated from Government use to public use[1]. Question 4 among the 9 specific questions is: "What are the cost trade-offs between equipment operation below 3 GHz and equipment operating between 3 and 5 GHz?" In this Appendix, we will address that question from the prospective of providing wide area coverage as has become traditional in the land mobile bands.

This traditional coverage from a high site is often in excess of 25 miles to a mobile on the street. This coverage is usually accomplished by generating between 75 and 250 watts of power at the base, and transmitting it through 5 dB of transmission line, circulator, and combining loss to an omnidirectional collinear antenna with gain between 7 and 12 dBd at a HAAT between 700 and 1500 feet. The base receiver uses a low noise figure preamplifiers mounted at the same gain antenna to provide a net receiver sensitivity of 0.35 μV. The mobile transmitter generates between 15 and 100 watts feeding a 1 to 3 dB loss coax attached to a "3 dB" or "5 dB" antenna. The 0.35 μV sensitivity mobile receiver comes off of the same antenna and coax as the transmitter.

First, we will compute the coverage of a "traditional" systems below 1.5 GHz. The cost of those systems is known and will be reported. Then, the equipment necessary to obtain the same coverage at 3 GHz and 5 GHz will be identified and a cost estimate will be generated for comparison. The most important single factor in the system design is the path loss, so we will start by identifying that.

PROPAGATION PATH LOSS
The path loss in the mobile multipath environment is significantly different than the free space path loss frequently discussed. This loss has been studied by several researchers as a function of the frequency of operation [2-4]. Figure 1 uses data from those studies to form a composite loss as a function of frequency, and a best fit to that data has been formed. At the present time, wide area coverage systems are in operation in the U.S. that use the 800 MHz band, and in Japan wide area systems operate at 800 MHz and 1.5 GHz.

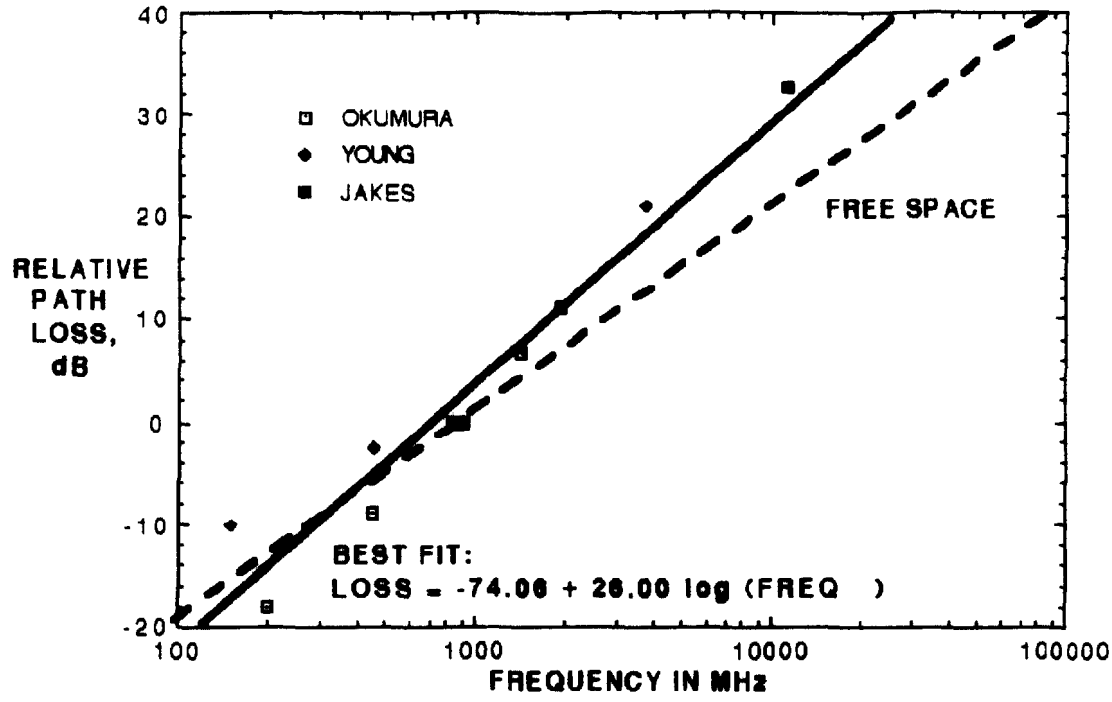

Figure A-1 Suburban path loss normalized to the 800/900 MHz band

The data of Okumura [4] shows a 6.6 dB increase in the loss between these bands, and the best fit to the data above shows a 6.0 dB increase. This difference has been verified by Motorola in the U.S. and in Japan during the development of equipment for the Japanese MCA systems. Thus, the data appears to be realistic. Using the best fit, the difference between the conventional 800 MHz band in the U.S. and various higher frequencies is tabulated below. As tabulated, the loss increases faster than free space, and at 5 GHz, the loss is 4.6 dB greater than free space. This probably occurs because the skin depth decreases as the frequencies increase, resulting in more I^2R loss to the wave as it reflects of surfaces in the multipath environment.

TABLE A-1 Relative Path Loss Vs Frequency

FREQUENCY IN MHz	RELATIVE PATH LOSS, dB FROM BEST FIT	FREE SPACE
860	0	0
2000	9.5	7.3
3000	14.1	10.9
4000	17.4	13.3
5000	19.9	15.3

The basic path loss that will be used through the rest of this appendix will be that of Okumura as numerically quantified in [5] for the 800 MHz band, increased by the factors from the best fit from table A-1 above.

ANTENNA GAIN

The additional propagation loss can be offset by several factors. The first is antenna gain which is shown for several omnidirectional base station antennas [6], as a function of frequency in Figure A-2. These antennas are all fiberglass enclosed with a radiating aperture of approximately 20 feet. It is evident that the gain is not continuing to increase as fast at higher frequencies, though theory says that the directive gain should increase 3 dB for every doubling in frequency for a constant aperture. This is because of practical implementation problems.

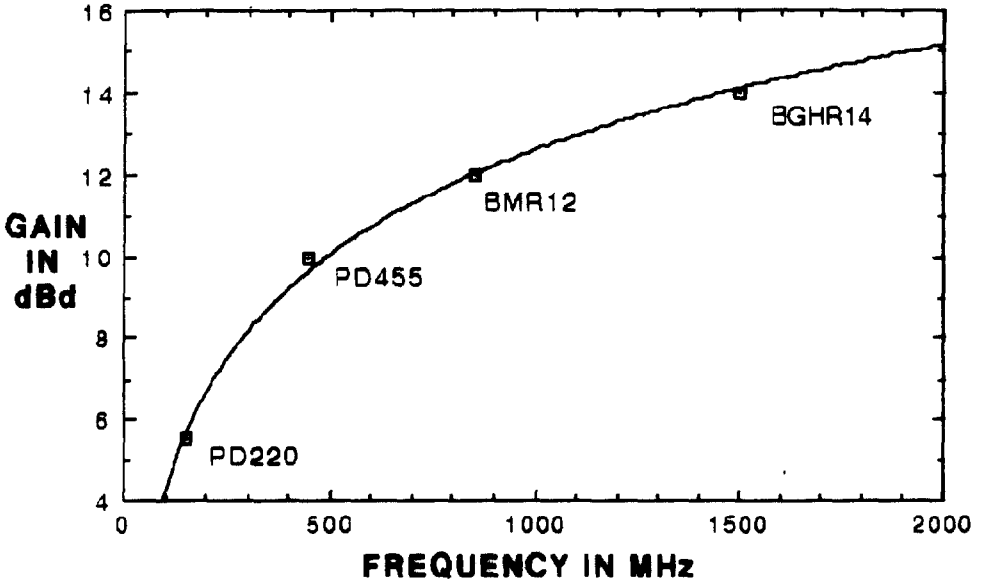

Figure A-2 Gain of 20 Foot Aperture Fiberglass Antennas

The loss associated with the feed network is one. At higher frequencies the loss for the same length of line increases. This can be offset by using larger (lower loss) transmission line, but because of the omnidirectional requirement there are limits to how far that can be taken.

The width of the antenna pattern main beam is the second limitation. The gain of an antenna is obtained by making the beam width narrower. But in order to maintain the coverage constant on the ground as the range is varied from the base outward, a sec (ø) pattern is required. This provides a limitation on how narrow the pattern can be. In addition, when the beam gets very narrow, the structure necessary to limit the wind from blowing the beam off of the ground becomes very expensive. These limitations are rapidly being approached with the gain antennas shown in figure A-2

However, it does appear that an additional 1 dB of gain could be expected at 2 GHz above that obtained at 1.5 GHz based on an extrapolation of the data in Figure A-4. Above that frequency, no increase in gain is possible when the requirement for omnidirectional coverage is maintained. A similar trend exists for mobile and portable antennas. A maximum exists, and it is very near to existing structures.

SYSTEM DESIGN AND COVERAGE

800 Band Analysis

Traditional land mobile wide area coverage at 90% of the locations 90% of the time is obtained using parameters such as shown in TABLE A-2. By adding the gains and subtracting the loss for these, the path loss can be computed, and the equations for Okumura path loss can be used to determine the range.

TABLE A-2 Computed Talk Out Range for an 800 MHz System

ITEM	GAIN
Transmitter Power, 75 W	48.8 dBm
Transmission Line/Combiner/Isolator Loss	-5.0 dB
Antenna Gain	14.2 dBi
Path Loss, Okumura Suburban from 1000'	-P.L.
"5 dB" Mobile Antenna	1.5 dBi
Coax Loss (10 feet RG-58A/U)	-2.0 dB
Log-Normal (6 dB sigma) Multipath 10% Loss	-8.0 dB
Rayleigh 10% loss	-10.0 dB
Receiver Sensitivity 0.35 μV	-116.1 dBm

39.5 - P.L. = -116.1
P.L. = 155.6 dBi

This loss permits a range of 26.5 miles coverage in the suburban environment as predicted by the Okumura propagation curves. The outbound path is shown here, but the inbound path is balanced to maintain the same range. The transmitter power in the mobile is less than that at the base, so additional gain is placed in the receiver path to obtain this result.

Analysis at Higher Frequencies

Now, we can determine the range that can be obtained at other frequencies. We will assume that larger coax or waveguide can be installed at the base site to maintain the 5 dB of loss between the transmitter and the antenna. As shown previously, there is only 2+1=3 dB of additional base antenna gain available at frequencies above the 800 MHz band resulting in 17.2 dBi. Because of the local multipath environment, we will only increase the mobile antenna gain by 2 dB to 3.5 dB, and it too will remain constant above 2 GHz. The 10 feet of RG-58A/U will be maintained resulting in increased loss as a function of frequency in addition to the path loss.

There are no propagation curves for the multipath environment at the frequencies of interest, therefore we will assume that the shape of the curves is the same as Okumura at 800 MHz with the additional loss computed below.

TABLE A-3 System Loss as a Function Of Frequency

ITEM	ADDITIONAL LOSS (dB) AT FREQUENCY, MHz 2000	3000	4000	5000
Antenna Gain	-5.5	-5.5	-5.5	-5.5
Coax Loss	1.7	3.2	4.6	6.1
Path Loss	9.5	14.1	17.4	19.9
Net Loss	5.7	11.8	16.5	20.5
Resulting Range, mi.	21.1	16.2	12.9	9.5

COST ANALYSIS

As shown, the range that results at 5 GHz with a constant 75 watts of Base power is about 1/3 that of traditional 800 MHz band systems. There is no known technology to get all of the additional system gain that is necessary to obtain the same wide area coverage from the same site. Thus, additional sites are necessary to provide that coverage at the higher frequencies. For the purpose of this analysis, we will assume that the number of sites is proportional to the area of coverage. The area and resulting number of sites at each frequency is shown in TABLE A-4.

TABLE A-4 Sites Required to Provide Wide Area Coverage

BAND, MHz	SINGLE SITE AREA IN SQ. MI.	NUMBER SITES
860	2206	1
2000	1398	2
3000	824	3
4000	523	5
5000	284	8

The cost of a site is a function of many parameters. A detailed analysis at this point is not necessary. However, it is possible to look at the cost of the base station and extrapolate some estimates of what might be possible at the higher frequencies. Figure A-3 shows the list price of a 75 watt Motorola trunked base repeater. A best fit second order polynomial fit to that data is used to extrapolate the cost to the higher frequencies of interest. TABLE A-5 shows the cost of these repeaters and the multiple that the higher frequencies are compared to the 800 MHz band.

TABLE A-5 List Price of Trunked Repeaters

BAND, MHz	COST$	MULTIPLE
860	5,561	1.00
2000	14,032	2.52
3000	24,380	4.38
4000	37,569	6.75
5000	53,659	9.65

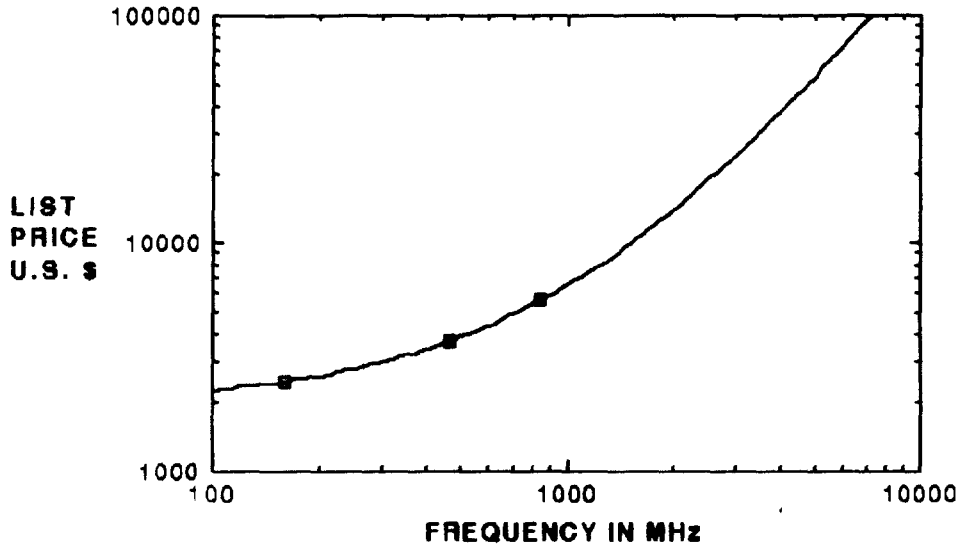

Figure A-3 List Price of Motorola Trunked Repeaters

Exact costs of each component are not necessary to make an estimate of the impact of going to higher frequencies. The components that are cost sensitive to going to higher frequencies will increase, and we will assume that the proportion will be the same as the base station costs identified above. The site rental is a small portion of the cost of the site, and for this analysis will be ignored. For multiple site systems there is a cost associated with communications between the sites, and that too will not be considered.

The cost of the infrastructure represents about 30% of the cost charged to a trunked subscriber. That and the analysis presented thus far allows us to determine the multiple that would be necessary to charge a wide area user at the higher frequencies. The multiple on the cost of a site multiplied by the number of sites necessary at each band will represent the infrastructure cost. We will assume that the mobile cost increases in the same rate as the base equipment. The projected percent of the cost of today's 800 MHz systems is thus determined in TABLE A-6

TABLE A-6 Total Cost To Subscriber
Expressed as % of Today's 860 MHz systems

BAND	% OF COST MOBILE	+	BASE	=	TOTAL
860	70		30		100
2000	70 X 2.52		30 X 2.52 X 2		327
3000	70 X 4.38		30 X 4.38 X 3		700
4000	70 X 6.75		30 X 6.75 X 5		1485
5000	70 X 9.65		30 X 9.65 X 8		2991

Thus, the projected cost of service to a subscriber at 5 GHz is almost 30 times more than the cost that is paid today.

CONCLUSIOIN

The cost of wide area coverage has been investigated as a function of the frequency band up to 5 GHz. The analysis presented herein is simplified, and it is possible to consider more detail which can reduce the multiples which are developed herein. However, the trend is very clear. The cost is much higher as the frequency increases beyond 2 GHz, and frequencies above 3 GHz do not appear to be viable candidates for this service.

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